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A Rate Equation for the Solution of Solid Iron in Liquid Copper*

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Abstract

In order to study the solution rate of solid iron in the copper-iron system which exhibits a positive great departure from ideality, a cylindrical iron was rotated in liquid copper or liquid Cu-Fe alloys for 60 to 240 sec at 240 revolutions per minute at 1220°, 1310° and 1385°C. The results are:

(1) The dependence of the solution rate on the iron concentration cannot be explained by the conventional rate equations in which the driving force is given by the difference between the concentrations of iron at the saturation and in the bulk liquid. A rate equation which expresses the driving force by the difference between the activities of iron at the saturation and in the bulk liquid, can approximately explain the solution rates.

(2) The rate constant K_c defined by the Berthoud equation has a tendency to decrease with an increase in iron concentration, but the rate constant K_a defined by the new equation has no clear dependence on the iron concentration except the case of 3.4%Fe at 1385°C.

(3) There is no significant difference between the values of K_c at 1310° and 1385°C. A linear relationship is established between the logarithm of K_a and the reciprocal of absolute temperature, giving the activation energy of 42 kcal·mol⁻¹.

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